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DTE Energy



10 CFR 50.73

December 17, 2003
NRC-03-0101

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington D C 20555

- References: 1) Fermi 2
NRC Docket No. 50-341
NRC License No. NPF-43
- 2) Detroit Edison Letter to NRC "Automatic Reactor Shutdown Due to Electric Grid Disturbance and Loss of Offsite Power," NRC-03-0079, dated October 10, 2003

Subject: Licensee Event Report No. 2003-002 Revision 1, "Automatic Reactor Shutdown Due to Electric Grid Disturbance and Loss of Offsite Power"

Pursuant to 10 CFR 50.73(a)(2)(iv)(A) and 10 CFR 50.73(a)(2)(i)(B), Detroit Edison is hereby submitting the enclosed revised Licensee Event Report (LER) No. 2003-002-01. This LER documents the automatic reactor shutdown on August 14, 2003 as a result of the regional electric grid disturbance and loss of offsite power and the subsequent failure of Combustion Turbine Generator (CTG) 11-1 to initially start.

No commitments are being made in this LER.

Should you have any questions or require additional information, please contact Mr. Norman K. Peterson of my staff at (734) 586-4258.

Sincerely,

William J. O'Connor Jr.

cc: H. K. Chernoff
M. A. Ring
M. V. Yudas, Jr.
NRC Resident Office
Regional Administrator, Region III
Wayne County Emergency Management Division

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(See reverse for required number of
digits/characters for each block)

Estimated burden per response to comply with this mandatory information collection request: 50 hours. Reported lessons learned are incorporated into the licensing process and fed back to industry. Send comments regarding burden estimate to the Records Management Branch (T-6 E6), U.S. Nuclear Regulatory Commission, Washington, DC 20555-0001, or by internet e-mail to bis1@nrc.gov, and to the Desk Officer, Office of Information and Regulatory Affairs, NEOB-10202 (3150-0104), Office of Management and Budget, Washington, DC 20503. If a means used to impose information collection does not display a currently valid OMB control number, the NRC may not conduct or sponsor, and a person is not required to respond to, the information collection.

1. FACILITY NAME Fermi 2				2. DOCKET NUMBER 05000341				3. PAGE 1 OF 6			
4. TITLE Automatic Reactor Shutdown Due to Electric Grid Disturbance and Loss of Offsite Power											
5. EVENT DATE			6. LER NUMBER			7. REPORT DATE			8. OTHER FACILITIES INVOLVED		
MO	DAY	YEAR	YEAR	SEQUENTIAL NUMBER	REV NO	MO	DAY	YEAR	FACILITY NAME	DOCKET NUMBER	
08	14	2003	2003	002	01	12	17	2003		05000	
9. OPERATING MODE 1			11. THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR 5: (Check all that apply)								
10. POWER LEVEL 100			20.2201(b)			20.2203(a)(3)(II)			50.73(a)(2)(II)(B)		50.73(a)(2)(ix)(A)
			20.2201(d)			20.2203(a)(4)			50.73(a)(2)(III)		50.73(a)(2)(x)
			20.2203(a)(1)			50.36(c)(1)(I)(A)			X	50.73(a)(2)(iv)(A)	73.71(a)(4)
			20.2203(a)(2)(I)			50.36(c)(1)(II)(A)			50.73(a)(2)(v)(A)		73.71(a)(5)
			20.2203(a)(2)(II)			50.36(c)(2)			50.73(a)(2)(v)(B)		OTHER Specify in Abstract below or in NRC Form 366A
			20.2203(a)(2)(III)			50.45(a)(3)(II)			50.73(a)(2)(v)(C)		
			20.2203(a)(2)(IV)			50.73(a)(2)(I)(A)			50.73(a)(2)(v)(D)		
			20.2203(a)(2)(V)			X	50.73(a)(2)(I)(B)		50.73(a)(2)(vii)		
			20.2203(a)(2)(VI)			50.73(a)(2)(I)(C)			50.73(a)(2)(viii)(A)		
			20.2203(a)(3)(I)			50.73(a)(2)(II)(A)			50.73(a)(2)(viii)(B)		
12. LICENSEE CONTACT FOR THIS LER											
NAME Robert J. Salmon - Principal Licensing Engineer								TELEPHONE NUMBER (Include Area Code) (734) 586-4273			
13. COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT											
CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX	CAUSE	SYSTEM	COMPONENT	MANU-FACTURER	REPORTABLE TO EPIX		
X	EK	INVT	L015	Y	D	EK	CNTR	G080	Y		
14. SUPPLEMENTAL REPORT EXPECTED								15. EXPECTED SUBMISSION DATE		MONTH	DAY
YES (if yes, complete EXPECTED SUBMISSION DATE).								X	NO		
16. ABSTRACT (Limit to 1400 spaces, i.e., approximately 15 single-spaced typewritten lines)											
<p>On August 14, 2003, at approximately 1610 hours, the Reactor Protection System initiated an automatic reactor scram from 100% power as a result of a Turbine Control Valve (TCV) fast closure. The TCV closure was caused by a turbine trip signal initiated by the main turbine-generator protective control system upon sensing electrical grid voltage fluctuations. A Loss of Offsite Power occurred as a result of the regional electric grid disturbance that affected several eastern and central states and portions of Canada and that led to blackout conditions in a large portion of the United States.</p> <p>All safety related systems operated as expected in response to this event. All control rods fully inserted into the reactor core. Reactor Pressure Vessel (RPV) water level decreased and the Reactor Core Isolation Cooling system was manually started to restore RPV level; however, the High Pressure Coolant Injection system automatically started when RPV water level reached the setpoint for Level 2. Primary containment penetration isolations associated with RPV Level 3 and 2 setpoints occurred as expected. All Main Steam Isolation Valves closed and all four Emergency Diesel Generators started and energized their pertinent emergency loads. Nine Safety Relief Valves lifted and reseated. Combustion Turbine Generator (CTG) 11-1 did not initially start in response to this event.</p> <p>Offsite power was restored on August 15, 2003, and the plant was restarted on August 18, 2003.</p>											

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17. NARRATIVE (If more space is required, use additional copies of NRC Form 366A)

Initial Plant Conditions:

Mode 1
Reactor Power 100 percent

Description of the Event

On the afternoon of August 14, 2003, a regional electric grid disturbance occurred in several eastern and central states and portions of Canada that led to blackout conditions in a large portion of the United States. Fermi 2 was operating at 100% power. At approximately 1605 hours, plant operators noted voltage fluctuations on the grid. At 1610 hours, continuing grid instability resulted in a turbine trip initiated by the main turbine-generator [TB] protective control system. A Turbine Control Valve (TCV) fast closure occurred and the Reactor Protection System (RPS) initiated a reactor scram as a result of the turbine trip. All control rods fully inserted into the reactor core.

At approximately 1611 hours, offsite power was lost and all Main Steam Isolation Valves [ISV] (MSIVs) closed due to the loss of RPS power caused by the Loss of Offsite Power (LOSP). All four Emergency Diesel Generators [DG] (EDGs) received an automatic start signal. Three EDGs (11, 12 and 14) automatically started from standby and loaded as expected. EDG 13 was out of service undergoing a monthly surveillance run; however, the EDG recovered from the test mode and lined up to its emergency mode of operation. An Unusual Event was declared at 1622 hours.

LOSP caused the loss of Feedwater flow and a decrease in Reactor Pressure Vessel (RPV) water level. The Reactor Core Isolation Cooling [BN] (RCIC) system was manually started to restore RPV level; however, the High Pressure Coolant Injection [BJ] (HPCI) system automatically started when RPV water level reached the setpoint for Level 2. HPCI and RCIC were used to supply water to the RPV until they both tripped on Level 8. RCIC was then manually restarted and used for level control. The operators noted a minimum RPV level of 112 inches above the Top of Active Fuel. Primary containment penetration isolations associated with RPV Level 3 and 2 setpoints occurred as expected.

Following MSIV closure, nine Safety Relief Valves [RV] (SRVs) lifted and reseated. Peak RPV pressure was about 1140 psig. Reactor pressure was then automatically controlled using the Low-Low Set mode of SRV A throughout the remainder of the event and recovery until the MSIVs were reopened and the main condenser was restored as a heat sink.

At about 1620 hours, the operators attempted to start Combustion Turbine Generator [TG] (CTG) 11-1, to power the balance of plant (BOP) buses; however, the CTG failed to start due to the trip of a battery-powered inverter which provides power to the igniters used to start the CTG. The CTG was locally started later that afternoon, around 1919 hours, using an alternate source of starting power provided by a portable generator. Restoration of electrical power continued in accordance with procedures. By 1332 hours on August 15, 2003, offsite power was fully restored and all four EDGs were shutdown. At 1348 hours, the Unusual Event was terminated.

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This event is being reported in accordance with 10 CFR 50.73(a)(2)(iv)(A) as an event or condition that resulted in a valid actuation of RPS and other plant Engineered Safety Features. It is also being reported under 10 CFR 50.73 (a)(2)(i)(B) as any operation or condition prohibited by Technical Specifications. A subsequent review of past operating history determined that CTG 11-1 had been considered operable on several occasions for the purpose of determining the Emergency Diesel Generator allowed out of service time per Technical Specification 3.8.1, Action A. As a result the allowed EDG out of service time had been exceeded.

Cause of the Event

The cause of turbine trip and the loss of offsite power is the regional electric grid disturbance on August 14, 2003. The reactor scram occurred as a result of the turbine trip before offsite power was lost.

The causes of the CTG 11-1 failure to start were an improper trip setpoint for the battery powered inverter and a failure to start the DC fuel oil pump due to a starter contact sticking open against its arcing horn. The improper inverter setpoint occurred because the inverter was not properly integrated into the overall system design during a 1996 modification/refurbishment. This resulted in the inverter low voltage setpoint not being identified or accounted for in design or startup test documentation. The result was that when inverter cards were replaced during corrective maintenance on August 22, 2001, the factory set low voltage DC trip setpoint was used which was too high for the Fermi 2 application. Thus, when called upon to operate under loss of power conditions, the inverter tripped on low battery voltage, even though battery voltage was adequate to support CTG 11-1 startup. The fuel oil pump contactor sticking was caused by less than adequate preventive maintenance in that the verification and/or adjustment of the arcing horn critical clearance dimensions was not specified or required. There was no requirement to check the arcing horn clearances during preventive maintenance.

Analysis of the Event

Section 15.2.2 of the Fermi 2 Updated Final Safety Analysis Report (UFSAR) describes a Generator Load Rejection transient and Section 15.2.6 describes a LOSP transient. A comparison of this event's scenario to the transients described in the UFSAR indicates that, with minor differences discussed below, plant systems operated as designed in response to the turbine trip and LOSP.

The Generator Load Rejection transient analysis in the UFSAR assumes a failure of the turbine bypass valves to open upon closure of the TCVs. In this event, the bypass valves opened to provide a steam path to the main condenser; however, when offsite power was lost shortly after the turbine trip, the MSIVs closed and isolated steam flow to the condenser. Therefore, MSIV closure had similar effects on steam flow as the failure of the turbine bypass valves to open.

In the UFSAR LOSP scenario, the turbine trip occurs as a result of the LOSP. In this event, the turbine trip was caused by grid instability. LOSP occurred about a minute after the turbine trip; however, once loss of offsite power occurred, plant systems responded as expected to the transient.

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The UFSAR LOSP scenario predicts all four EDGs to start in 3 seconds and their breakers to close in 13 seconds. In this event, EDG 13 was in a Limiting Condition of Operation (LCO) that was entered at 1215 hours on August 14 to perform a surveillance run. The EDG was operating parallel to the grid when the transient occurred; however, it recovered from the test mode and loaded as expected after about one minute. The other three EDGs started and loaded within the expected time. The minor delay in EDG 13 loading had no significant effect on other plant systems response to the transient.

CTG 11, Unit 1, is not a safety related system but is utilized as the alternate power source for a Station Blackout (SBO) event (loss of both offsite and onsite emergency power) and to support response from the Dedicated Shutdown Panel to an Appendix R fire (which assumes a loss of offsite power condition). The unit failed to start when operators attempted to manually start it from the main control room to supply BOP loads; however, it was locally started about three hours later. The delay in starting this unit had no significant effect on the plant response to the actual transient because the CTG was not required for the mitigation of this event.

The trip setpoint for the CTG 11-1 battery powered inverter had been improperly set since August 22, 2001 when inverter cards were replaced during corrective maintenance with a factory set low voltage DC trip setpoint too high for the Fermi 2 application. The inverter powers equipment needed to start CTG 11-1 under loss of offsite power conditions. This resulted in CTG 11-1 being inoperable since that date. Thus from August 22, 2001 until the date of this event (August 14, 2003), CTG 11-1 was not able to perform under loss of offsite power conditions, or to support the Appendix R assumption that a station blackout occurs simultaneously with a transfer of controls to the alternate shutdown panel.

Technical Specification 3.8.1 requires all EDGs to be operable in Modes 1, 2, and 3, except that per the associated action statements, one EDG may be inoperable for up to 72 hours with CTG 11-1 inoperable or up to 7 days (168 hours) when CTG 11-1 is operable. However, because the plant staff was unaware that CTG 11-1 was inoperable for the approximate two year period, it was assumed to be operable when determining allowable EDG out of service times in accordance with Technical Specification 3.8.1, Action A. Six instances occurred during the approximate two-year period when EDG outages were allowed to extend past the 72 hours allowed with CTG 11-1 inoperable, but within the 7 days allowable with an operable CTG-11. Specifically, the following EDG outages were extended beyond the 72 hours: The August 20, 2001 EDG 14 outage was performed within 121 hours. The May 6, 2002 EDG 12 Outage was performed within 104 hours. The January 27, 2003 EDG 11 outage was performed within 146 hours. The June 2, 2003 EDG 12 outage was performed within 109 hours. The June 9, 2003 EDG 13 Outage was performed within 79 hours. The June 16, 2003 EDG 14 outage was performed within 109 hours. These EDG outages averaged about 111 hours or 39 hours over the 72 hours allowable.

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The sticking CTG 11-1 fuel oil pump contactor was readily detected and accounted for about 35 minutes of the CTG 11-1 start delay. The contactor functioned properly when it was last tested in May 2003, and it cannot be determined when it became inoperable. However, this condition was detected and temporarily remedied within about 35 minutes after the inverter issue was resolved on August 14, 2003. It would, however, affect the ability for CTG 11-1 to assume load within 15 minutes as assumed for the Appendix R fire alternate shutdown panel scenario. The contactor worked properly when last tested on May 30, 2003 and during all previous tests. This isolated occurrence had an insignificant effect on plant safety.

CTG 11-1 was unavailable during the approximately two year period to support plant shutdown from outside of the control room for an Appendix R fire concurrent with a loss of offsite power. However, the remaining overall fire protection program, including the control of combustible loads in the control center envelope, the availability of fire detection and suppression systems, and the ability to shut the plant down from the dedicated shutdown panel with available offsite power were in place. Therefore, the health and safety of the public were not adversely affected by this condition.

As discussed above, CTG 11-1, is not a safety related system but is utilized as the alternate power source for a Station Blackout (SBO) event (loss of both offsite and onsite emergency power). It is assumed to start within 1 hour for the SBO event. CTG 11-1 availability is also required by the Technical Specification 3.8.1 Action A when extending EDG outages past 72 hours but within 7 days. CTG 11-1 is also used to support plant operations during a loss of offsite power, and despite the approximate 3 hour start delay, it was used in response to this event. The overall effect of CTG 11-1 unavailability on plant risk, considering all of these uses over the approximate two year period has been reviewed and is considered to be of low safety significance.

Corrective Actions

The reactor was restarted on August 18, 2003, the turbine generator was synchronized to the grid on August 20, 2003 and the plant returned to full power on August 21, 2003.

This event is characterized as a transient that has been evaluated as part of the plant's design basis analysis. All plant safety related systems operated as expected in response to the event. The event and the minor differences between it and the analyzed transients in the UFSAR have been documented in the Fermi 2 corrective action program. Any further actions relating to this event will be developed and implemented commensurate with the established processes of the Fermi 2 corrective action program.

A plant modification has been implemented to properly integrate the inverter low voltage setpoint into the CTG 11-1 design. It specifies and sets the CTG 11-1 inverter low voltage trip setpoint between 93.1 and 93.6 Volts to ensure it will not trip when battery voltage is sufficient to start CTG 11-1. The Fermi 2 Central Component database (CECO) has been revised to include this inverter trip setpoint, and a preventive maintenance activity has been established to check the low voltage setpoints every 18 months.

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A black start test was also performed on September 4, 2003 to verify CTG 11-1 operability under black start conditions. It is planned to perform simulated CTG 11-1 black start tests every 18 months.

The DC Fuel pump contactor arcing horn was adjusted to prevent binding on August 16, 2003 after the use of CTG 11-1 in response to the loss of offsite power condition and before restart of the plant. Similar contactors were inspected during the September 2003 CTG 11-1 maintenance outage. No additional problems were found that would have resulted in contactor interference. It is planned to add an inspection and adjustment of the arcing horn to preventive maintenance activities for all CTG 11-1 contactors with arcing horns.

Additional Information

A. Failed Components:

Component: Combustion Turbine Generator 11, Unit 1, Inverter
Function: Converts battery DC power to AC power for starting the CTG
Manufacturer: La Marche Manufacturing Company
Model Number: A31-2K-120V-A6
Failure Cause: Improper Trip Setpoint

Component: DC Contactor
Function: Applies DC Power to DC Fuel Oil Pump
Manufacturer: General Electric
Model Number: IC2800
Failure Cause: Contact sticking on arcing horn

B. Previous LERs on Similar Problems:

There has been no previous total loss of offsite power events at Fermi 2, and no CTG 11-1 start failures due to improper inverter trip setpoints or contactor sticking.